UNIVERSITAS MUHAMMADIYAH JAKARTA
FAKULTAS KEDOKTERAN DAN KESEHATAN

SURAT TUGAS
Nomor : 39B/F.7-UMJ/III/2023

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Untuk **mengembangkan bahan kuliah Farmakologi Dasar Kebidanan pada Program Studi Kebidanan Program Sarjana**

Demikian surat tugas ini diberikan kepada yang bersangkutan untuk dilaksanakan sebagai amanah.

Jakarta, 10 Maret 2023
Dekan Fakultas Kedokteran dan Kesehatan UMJ

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Tembusan :
1. Wadek I, II
2. Bag Keuangan
3. Arsip

HORMON

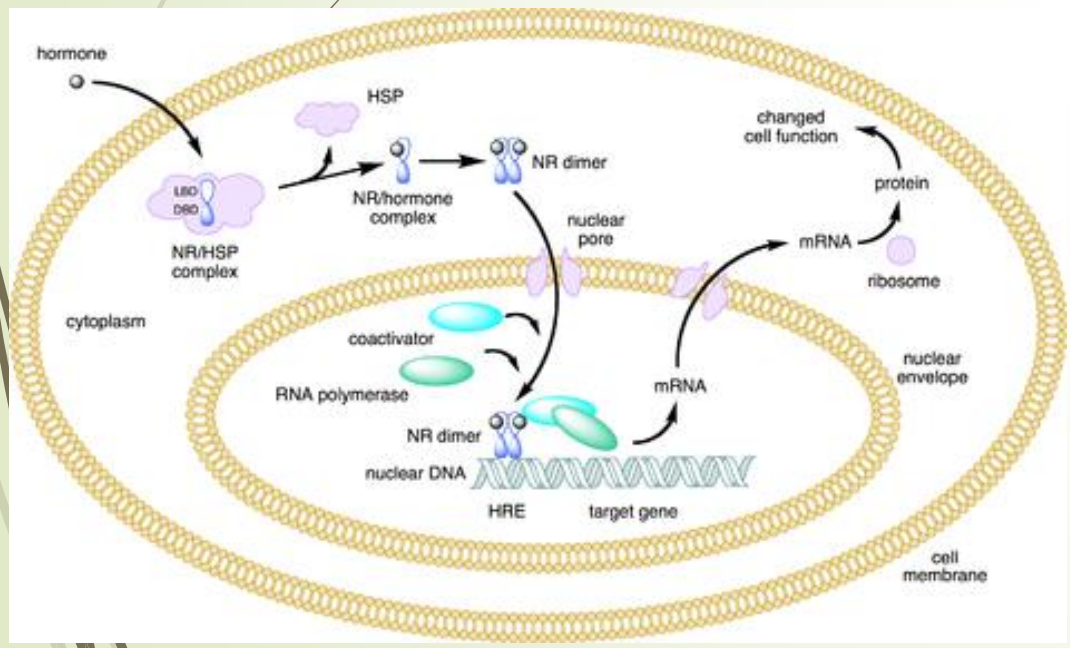
dr. Rina Nurbani, M.Biomed, Sp.Ak

General Concepts

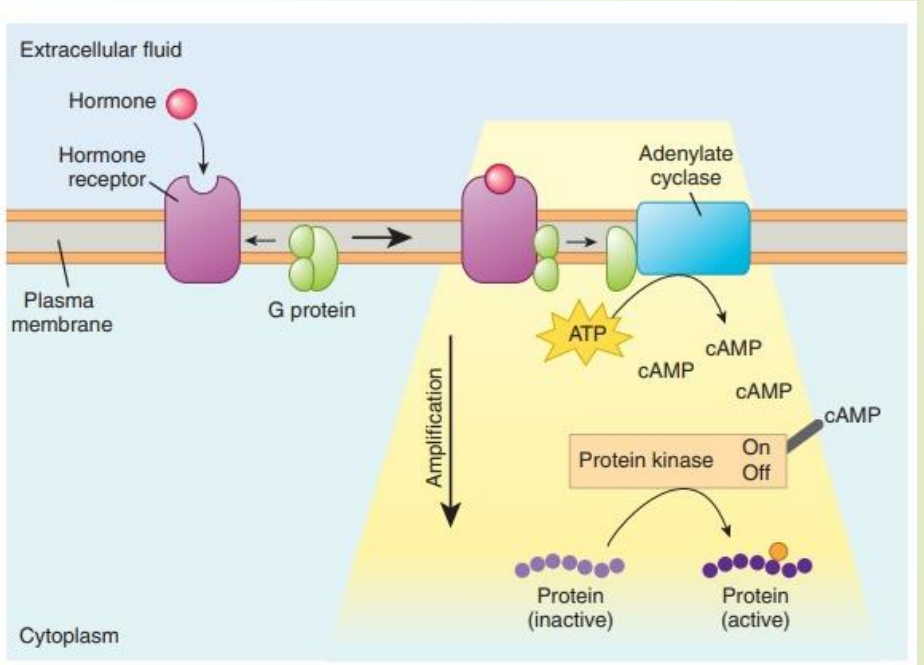
- **Endocrinology**
  - Biosynthesis of hormones
  - Hormones' sites of production
  - Sites and mechanisms of hormones' action and interaction
- **Hormone**
  - Chemical messenger circulates in body fluids and produces specific effects on cells distant from the hormone's point of origin
- **Functions**
  - Regulation of energy: storage, production, utilization
  - Adaptation to new environments or conditions of stress
  - Facilitation of growth and development
  - The maturation and function of the reproductive system

General Concepts

- **Hormones may be divided into two classes:**
  - Hormones act predominantly via *nuclear receptors* → modulate transcription in target cells (e.g., steroid hormones, thyroid hormones)
  - Hormones that typically act via *membrane receptors* → rapid effects on signal transduction pathways (e.g., gonadotrophin)



Steroid hormones



Gonadotropin hormones

The Hypothalamic-Pituitary-Adrenal (HPA) Axis

- Many of the classic endocrine hormones (e.g., cortisol, thyroid hormone, sex steroids, GH) are regulated by interaction among the hypothalamus, anterior pituitary, and endocrine glands (Table 42-1 & Figure 42-1)
- On stimulation, hypothalamic neurons secret their respective hypothalamic hormones to anterior pituitary gland
- Hypothalamic hormones bind to membrane receptors on specific pituitary cells→ regulate secretion of corresponding pituitary hormones
- Pituitary hormones "**master signals**"→ circulate→ target endocrine glands or other tissues→ activate specific receptors→ stimulate synthesis & secretion→ target endocrine hormones or exert other tissue-specific effects (**feed-forward regulation)**
- **Negative-feedback regulation**: target endocrine hormone causes negative-feedback inhibition of hormone release by acting at the hypothalamus and the pituitary (Figure 42-2)

TABLE 42–1 ■ HORMONES THAT INTEGRATE THE HYPOTHALAMIC-PITUITARY-ENDOCRINE AXIS

HYPOTHALAMIC HORMONE	EFFECT ON PITUITARY TROPHIC (SIGNAL) HORMONE	TARGET HORMONE(S)
Growth hormone-releasing hormone	↑↑ Growth hormone	IGF-1
Somatostatin	↓ Growth hormone ↓ Thyroid-stimulating hormone	
Dopamine	↓ Prolactin	—
Corticotropin-releasing hormone	↑ Corticotropin	Cortisol
Thyrotropin-releasing hormone	↑ Thyroid-stimulating hormone ↑ Prolactin	Thyroid hormone
Gonadotropin-releasing hormone	↑ Follicle-stimulating hormone ↑ Luteinizing hormone	Estrogen (f) Progesterone/estrogen (f) Testosterone (m)

f, female; m, male; ↑, increased production; ↓, decreased production.

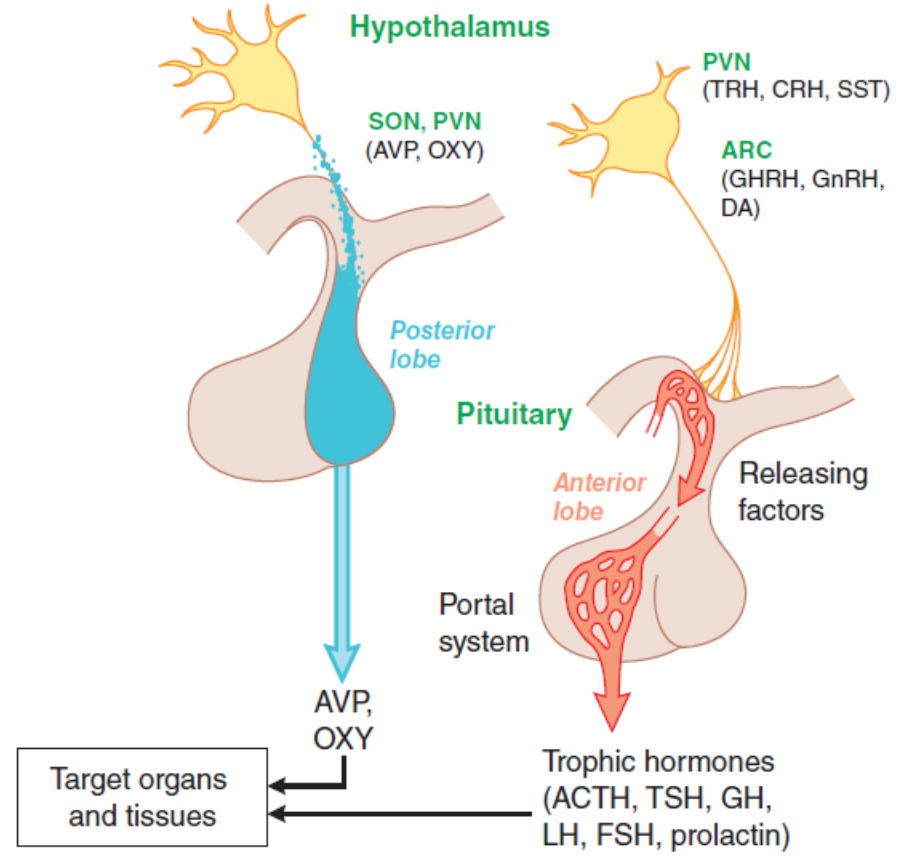


Figure 42–1 *Organization of the anterior and posterior pituitary gland.* Hypothalamic neurons in the supraoptic (SON) and paraventricular (PVN) nuclei synthesize arginine vasopressin (AVP) or oxytocin (OXY). Most of their axons project directly to the posterior pituitary, from which AVP and OXY are secreted into the systemic circulation to regulate their target tissues. Neurons that regulate the anterior lobe cluster in the mediobasal hypothalamus, including the PVH and the arcuate (ARC) nuclei. They secrete hypothalamic releasing hormones, which reach the anterior pituitary via the hypothalamic-adenohypophyseal portal system and stimulate distinct populations of pituitary cells. These cells, in turn, secrete the trophic (signal) hormones, which regulate endocrine organs and other tissues. ARC, arcuate; AVP, arginine vasopressin; OXY, oxytocin; PVN, paraventricular nuclei; SON, supraoptic nuclei; See Abbreviations list for other abbreviations.

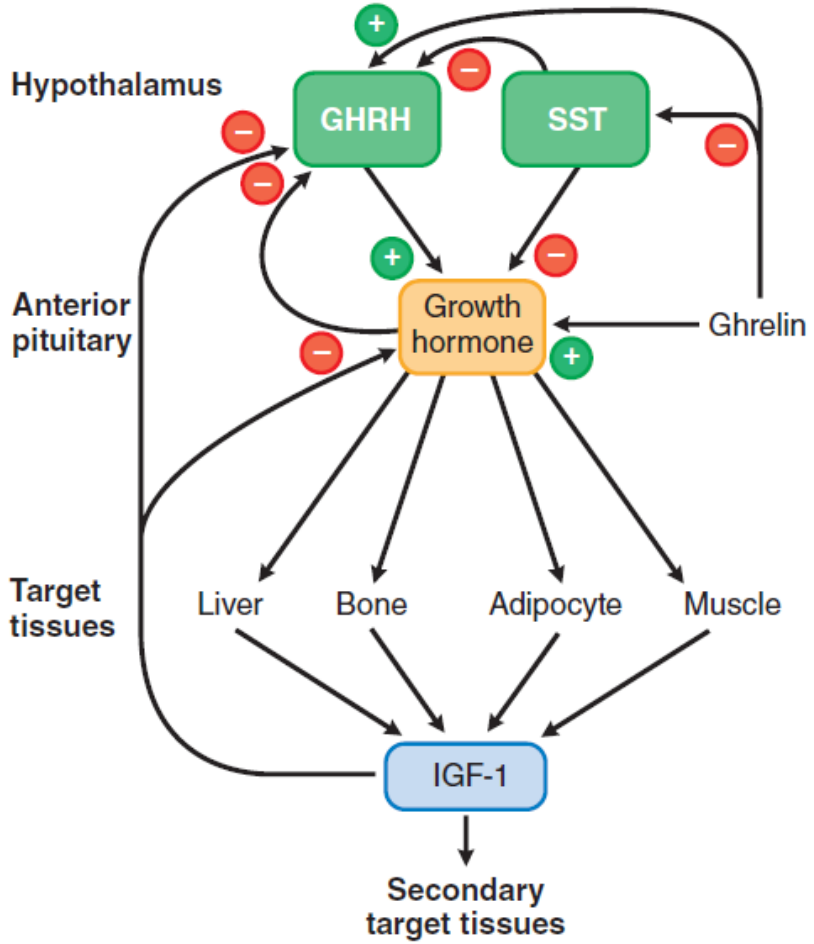


Figure 42–2 *Growth hormone secretion and actions.* Two hypothalamic factors, GHRH and SST, stimulate or inhibit the release of GH from the pituitary, respectively. IGF-1, a product of GH action on peripheral tissues, causes negative-feedback inhibition of GH release by acting at the hypothalamus and the pituitary. The actions of GH can be direct or indirect (mediated by IGF-1). See text for discussion of the other agents that modulate GH secretion and of the effects of locally produced IGF-1. Inhibition, –; stimulation, +.

Pituitary Hormones and Their Hypothalamic-Releasing Factors

- **Classification of the anterior pituitary (adenohypophysis) hormones** (Table 42-2)
  1. POMC-derived hormones:
     - Corticotropin (ACTH) and α-MSH
  2. Somatotropic family of hormones
     - GH, PRL & placental lactogen
  3. Glycoprotein hormones
     - TSH (thyrotropin), LH (lutropin), FSH (follitropin), hCG
- **The Posterior Pituitary Gland's (neurohypophysis) Hormones**
  1. Arginine Vasopressin (AVP)
     - Water homeostasis
  2. Oxytocin (OXY)
     - Labor and parturition
     - Milk letdown

TABLE 42–2 ■ PROPERTIES OF THE PROTEIN HORMONES OF THE HUMAN ADENOHYPOPHYSIS AND PLACENTA

CLASS Hormone	MASS (daltons)	PEPTIDE CHAINS	AMINO ACID RESIDUES	Comments
POMC-derived hormones[a]				
Corticotropin	4500	1	39	These peptides are derived by proteolytic processing of the common precursor, POMC.
α-Melanocyte–stimulating hormone	1650		13	
Somatotropic family of hormones				
Growth hormone	22,000	1	191	Receptors for these hormones belong to the cytokine superfamily.
Prolactin	23,000		199	
Placental lactogen	22,125		190	
Glycoprotein hormones				
Luteinizing hormone	29,400	2	β-121	These are heterodimeric glycoproteins with a common α subunit of 92 amino acids and unique β subunits that determine biological specificity and $t_{1/2}$.
Follicle-stimulating hormone	32,600		β-111	
Human chorionic gonadotropin	38,600		β-145	
Thyroid-stimulating hormone	28,000		β-118	

[a]See Chapter 46 for further discussion of POMC-derived peptides, including ACTH and α-MSH.

Growth Hormone (GH) and Prolactin (PRL) (1)

- **Structures of GH and PRL**
  - GH & PRL are members of the somatotropic hormone family
  - GH & PRL act via membrane receptors
  - GH is secreted by somatotropes
  - PRL is secreted by lactotropes
- **Molecular and Cellular Bases of GH and PRL Action**
  - GH and PRL interact with specific membrane receptors on target tissues→ effects (Figure 42-5)
  - GH receptor activation results in the binding of a single GH to two receptor monomers→ induce a conformational change→ activates downstream signaling
  - PRL interact with a cytokine family receptor on target cells through many of the same pathways as the GHR

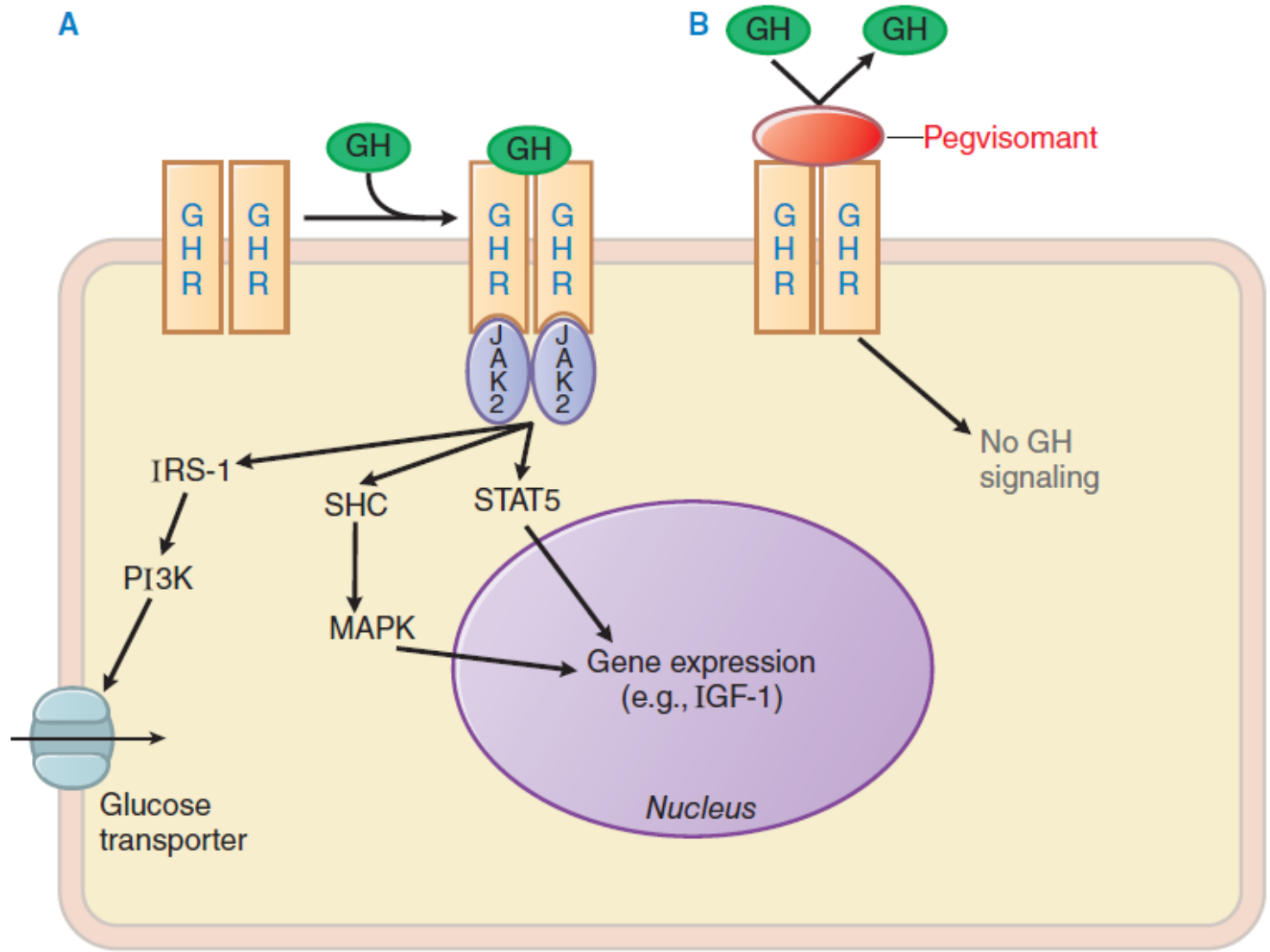


Figure 42–5 *Mechanisms of GH and PRL action and of GHR antagonism.* **A.** GH and two GHRs form a ternary complex that induces association and Tyr autophosphorylation of JAK2 and of docking sites on the cytoplasmic tail of GHRs. JAK2 phosphorylates cytoplasmic proteins that activate downstream signaling pathways, including STAT5 and mediators upstream of MAPK, which ultimately modulate gene expression. The structurally related PRL receptor also is a ligand-activated homodimer that recruits the JAK-STAT signaling pathway. GHR also activates IRS-1, which may mediate the increased expression of glucose transporters on the plasma membrane. **B.** Pegvisomant, a recombinant pegylated variant of human GH, is a high-affinity GH antagonist that interferes with GH binding.

Growth Hormone (GH) and Prolactin (PRL) (3)

- **Physiological Effects of GH and PRL**
  - GH stimulate: longitudinal growth of bones, preadipocyte to adipocytes
  - GH↑: bone mineral density after epiphyses have closed, muscle mass, GFR
  - GH has potent anti-insulin actions in liver & peripheral tissues (adipocytes & muscle)→ ↓glucose utilization & ↑lipolysis
  - Most of GH anabolic & growth-promoting effects are mediated indirectly through the induction of IGF-1. IGF-1 interacts with receptors on the cell surface mediate its biological activities.
  - PRL effects are limited primarily to the mammary gland: inducing growth & differentiation of ductal & lobuloalveolar epithelia, essential for lactation.
  - PRL receptors present in: hypothalamus, liver, adrenal, testes, ovaries, prostate, immune system

Growth Hormone (GH) and Prolactin (PRL) (4)

- **Indication of GH Treatment**
  - GH deficiency in children
  - Children with short stature with adequate GH production, Turner syndrome, chronic renal insufficiency, children born small for gestational age
  - AIDS-associated wasting and for malabsorption associated with short-bowel syndrome
- **Contraindications of GH**
  - Acute critical illmess: complication after open heart or abdominal surgery, multiple accidental trauma, acute respiratory failure
  - Active malignancy

Growth Hormone (GH) and Prolactin (PRL) (5)

Drug Facts for Your Personal Formulary: *Pituitary-Related Drugs*

Drugs	Therapeutic Uses	Clinical Pharmacology and Tips
Pituitary Hormones (Recombinant)		
Growth hormone (somatropin)	• Stimulating growth in childhood • In GH-deficient adults, replacing GH	• Given by daily SC injection to stimulate body growth, primarily through stimulation of IGF-1. As growth ceases, test for GH deficiency to determine if GH should be continued into adulthood. • Given only to adults with GH deficiency proven by GH stimulation tests or known organic childhood GH deficiency and low IGF-1 levels on testing off GH treatment. • Treatment in adults decreases fat mass, increases muscle mass, increases bone mass, and improves quality of life.

Thyroid Hormones

- **Thyroid follicle produces**
  - Iodothyronine hormones T4 (predominantly, prohormone)
  - T3 the active form (T4 converted in the liver and other tissues)
- **Thyroid's parafollicular cells (C cells) produ**
  - Calcitonin (indication: hypercalcemia, osteo

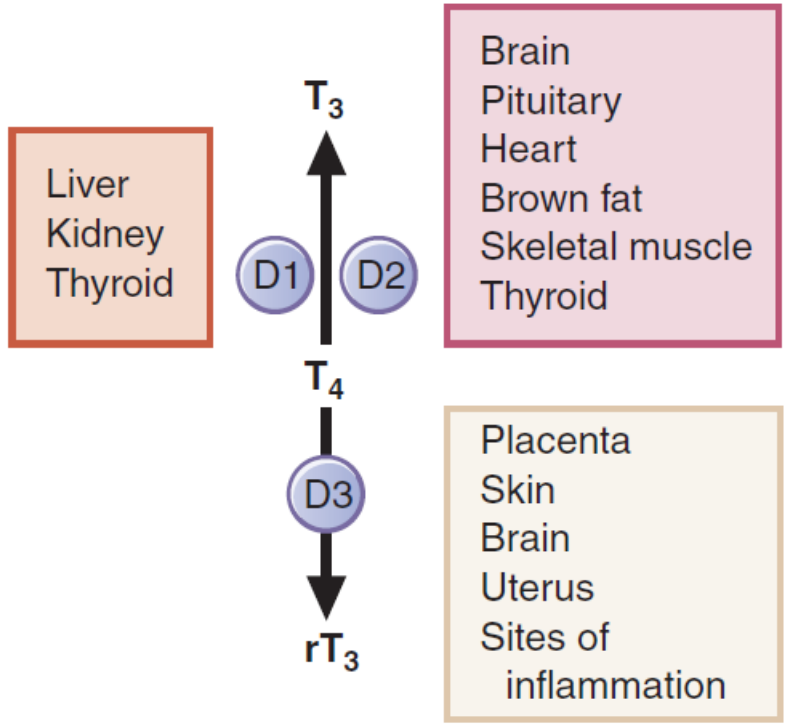


Figure 43–4 *Peripheral T4 → T3 conversion by deiodinase enzymes.*

Thyroid H

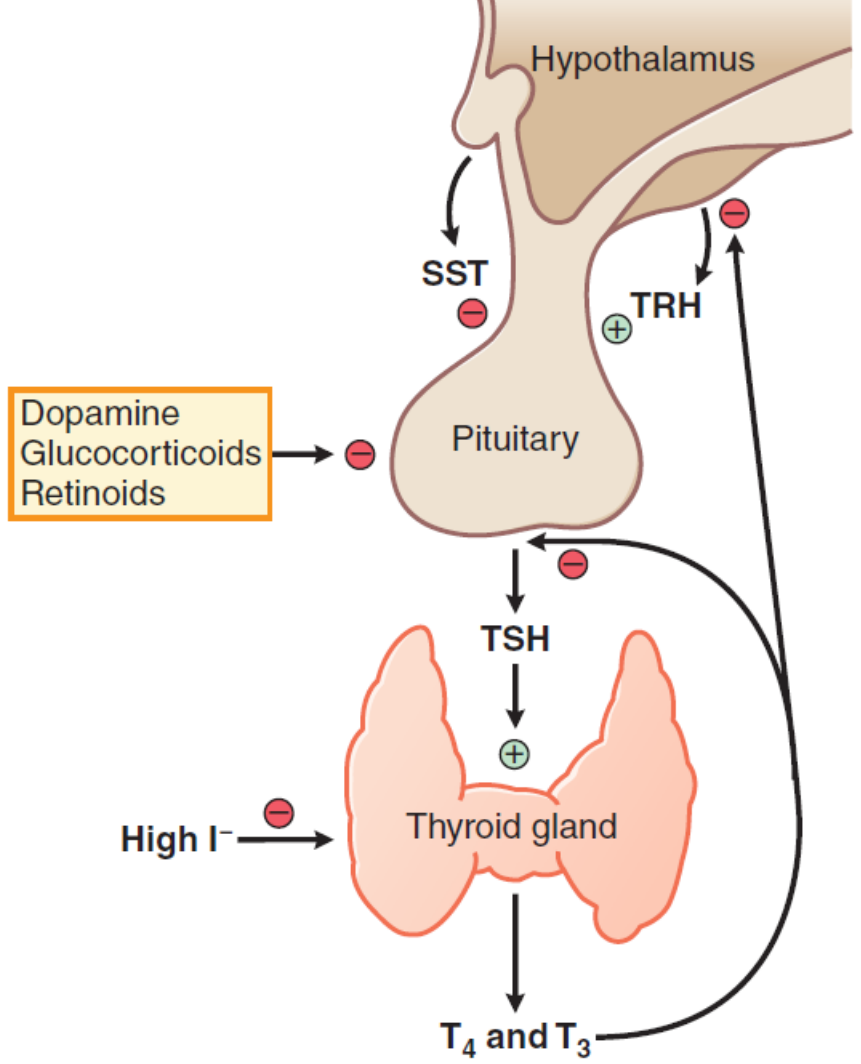


Figure 43–6 *Regulation of thyroid hormone secretion.* Myriad neural inputs influence hypothalamic secretion of TRH. TRH stimulates release of TSH from the anterior pituitary; TSH stimulates the synthesis and release of the thyroid hormones T_3 and T_4. T_3 and T_4 feed back to inhibit the synthesis and release of TRH and TSH. SST can inhibit TRH action, as can dopamine and high concentrations of glucocorticoids. Low levels of I^- are required for T_4 synthesis, but high levels inhibit T_4 synthesis and release.

Thyroid Hormones

- **Clinical Effects of Thyroid Hormones**
  - **Growth and Development.** In humans, thyroid hormone plays a critical role in **brain development** (the absence of thyroid hormone during periode of active neurogenesis up to 6 months postpartum→irreversible mental retardation/**cretinism**)
  - **Thermogenic Effects.** Heat resulting from vital processes and facultative
  - **Cardiovascular Effects.** Tachycardia, ↑stroke volume, cardiac hypertrophy, ↓peripheral vascular resistance
  - **Metabolic Effects.** Thyroid hormone stimulate expression hepatic LDL receptor (↓thyroid→ ↑cholesterolemia).
- **Therapeutic Uses of Thyroid Hormone**
  - Hormone replacement therapy in patients with hypothyroidism (Levothyroxine)
  - TSH suppression therapy in patients with thyroid cancer

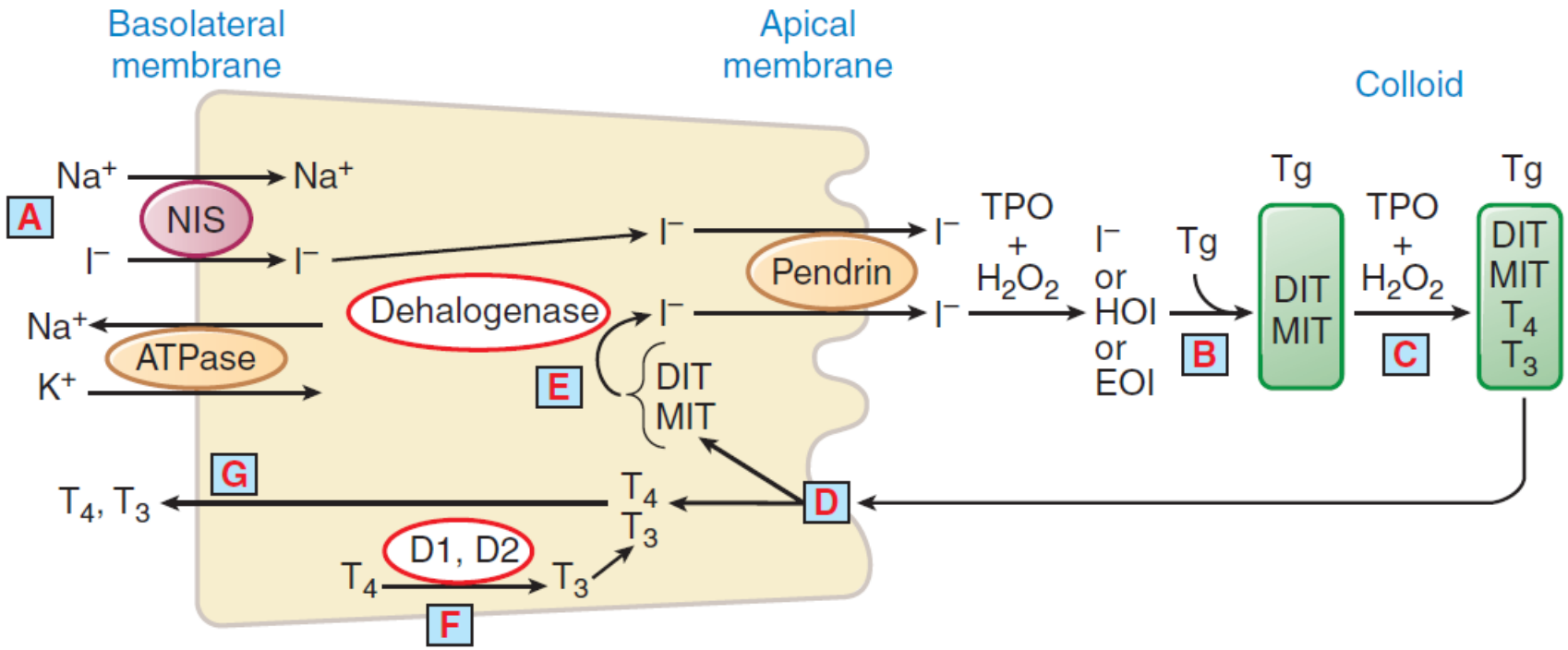
Antithyroid Drugs

- **Types:**
  - antithyroid drugs, which interfere directly with the synthesis of thyroid hormones
  - Antithyroid drugs, which interfere directly with the synthesis of thyroid hormones
  - High concentrations of iodine, which decrease release of thyroid hormones from the gland and also may decrease hormone synthesis
  - Radioactive iodine, which damages the thyroid gland with ionizing radiation
- **Mechanism of Action**
  - antithyroid drugs inhibit the formation of thyroid hormones by interfering with the incorporation of iodine into tyrosyl residues of thyroglobulin; inhibit coupling of these iodotyrosyl residues to form iodothyronines (Figure 43-2)
  - **Propylthiouracil (PTU)** partially inhibits peripheral deiodination T4 to T3 (**methimazole** does not have this effect)→ PTU drug of choice in the treatment of severe hyperthyroid or thyroid storm

Antithyroid Drugs

TABLE 43–3 ■ AGENTS THAT DISRUPT THYROID HORMONE SYNTHESIS, RELEASE, AND METABOLISM

MECHANISM	AGENT
Iodide uptake	Perchlorate, fluoroborate, thiocyanate, nitrate
Organification of iodine	Thionamides (propylthiouracil, methimazole, carbimazole), thiocyanate, sulfonamides
Coupling reaction	Sulfonamides, thionamides
Hormone release	Li^+ salts, iodide
Peripheral iodothyronine deiodination	Propylthiouracil, amiodarone, oral cholecystographic agents
Accelerated hepatic metabolism	Phenobarbital, rifampin, carbamazepine, phenytoin, sertraline, bexarotene



	METABOLIC STEP	INHIBITOR
A	Iodine transport	ClO_4^-, SCN
B	Iodination	PTU, MMI
C	Coupling	PTU, MMI
D	Colloid Resorption	Colchicine, Li^+, I^-
E	Deiodination of DIT + MIT	Dinitrotyrosine
F	Deodination of T_4	PTU
G	Secretion	I^-

Figure 43–2 *Major pathways of thyroid hormone biosynthesis, storage as colloid, and release.*

Antithyroid Drugs

- **Therapeutic Uses:**
  - As definitive treatment, to control the disorder in anticipation of a spontaneous remission in Graves disease
  - In conjunction with radioactive iodine, to hasten recovery while awaiting the effects of radiation
  - To control the disorder in preparation for surgical treatment
  - Methimazole is drug of choice for Graves disease; less toxic than PTU

Drug Facts for Your Personal Formulary: *Thyroid and Antithyroid Drugs*

Drugs	Therapeutic Uses	Clinical Pharmacology and Tips
Thyroid Hormone Preparations: Replace T_4 or T_3 normally produced by the thyroid		
Levothyroxine (T_4)	• Hypothyroidism • TSH suppression in thyroid cancer	• Plasma $t_{1/2}$ ~ 1 week • Deiodinases convert circulating T_4 to the bioactive hormone T_3 • Dosage generally needs to increase during pregnancy • Congenital hypothyroidism requires rapid diagnosis and correction to allow normal physical and mental development • Overtreatment can lead to osteoporosis and atrial fibrillation
Liothyronine (T_3)	• When rapid onset of action is desired (sometimes for myxedema coma) • When rapid termination of action is desired (preparing patients with thyroid cancer for radioiodine therapy)	• Plasma $t_{1/2}$ ~ 18-24 h • Multiple daily doses needed to achieve needed C_{Pss} • Levothyroxine (T_4) generally preferred over liothyronine (T_3) for the long-term therapy of hypothyroidism
Desiccated thyroid and T_4-T_3 mixtures	• Generally not a preferred therapy, although occasional hypothyroid patients say they feel better than when taking levothyroxine	• Mixture of levothyroxine and liothyronine (2–5:1 by weight) • Supplies a relative excess of T_3 compared to normal thyroidal secretion, which is ~ 11:1 T_4 to T_3 by weight • No convincing evidence of greater efficacy than levothyroxine (T_4 alone)
Antithyroid Drugs: Thionamides: Interfere with incorporation of iodine into tyrosyl residues and inhibit iodotyrosyl-coupling reactions		
Methimazole	• Reduce thyroid hormone production	• Carbimazole (available in Europe) converted to methimazole after absorption • Long intrathyroidal $t_{1/2}$ allows once-daily dosing for most patients • Preferred antithyroid drug • Do not use in first trimester of pregnancy due to embryopathy
Propylthiouracil	• Reduce thyroid hormone production • May also reduce T_4 to T_3 conversion	• Major concern is liver toxicity; rare but more commonly seen in children and pregnancy • Only indications are for thyroid storm due to action on reducing T_4 to T_3 conversion and in the first trimester of pregnancy
Antithyroid Drugs: Ionic Inhibitors: Iodine uptake by antagonizing the sodium-iodide symporter		
Perchlorate	• Primarily used to enhance the response to thioamides in refractory Graves disease (e.g., that associated with amiodarone)	• Not available commercially; must be specialty compounded

Drug Facts for Your Personal Formulary: *Thyroid and Antithyroid Drugs*

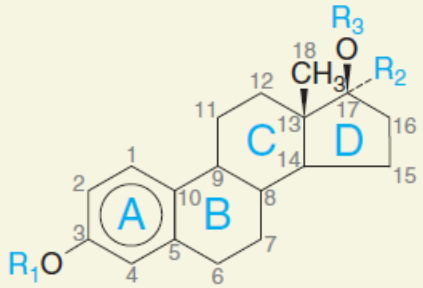
Drugs	Therapeutic Uses	Clinical Pharmacology and Tips
Antithyroid Drugs: Iodide: Acute reduction in thyroid hormone		
Lugol solution	• Acutely reduce the secretion and synthesis of thyroid hormone	• "Escape" from thyroid inhibition after 7–10 days • Strictly contraindicated in pregnancy
KISS: potassium iodide saturated solution (or SSKI)	• Acutely reduce the secretion and synthesis of thyroid hormone	• "Escape" from thyroid inhibition after 7–10 days • Strictly contraindicated in pregnancy
Antithyroid Drugs: Radioactive Iodine: Used to destroy hyperfunctioning thyroid tissue		
^{131}I	• Effective for permanent treatment of Graves disease and toxic nodule or toxic goiter • Destruction of iodide-avid thyroid cancer	• Highly effective for permanent cure to hyperthyroidism • Effective treatment of hyperthyroidism usually results in permanent hypothyroidism and lifelong requirement for levothyroxine replacement • Absolutely contraindicated in pregnancy • Treatment of thyroid cancer requires TSH stimulation (endogenous or exogenous)
Recombinant Human TSH Agonist for the TSH Receptor		
Thyrotropin alpha	• Stimulate radioiodine uptake and thyroglobulin release in patients with thyroid cancer after thyroidectomy • Prepare patients for radioiodine ablation of thyroid remnants after thyroidectomy for thyroid cancer	• Allows assessment of residual or recurrent thyroid cancer without stopping levothyroxine and becoming clinically hypothyroid • Allows radioiodine therapy of thyroid remnants without stopping levothyroxine and becoming clinically hypothyroid
Thyroid Cancer Chemotherapeutics: Tyrosine kinase inhibitors		
Sorafenib Lenvatinib	• Radioiodine-resistant, progressive papillary, or follicular thyroid cancer	• Response not predicted by presence or absence of specific oncogene mutations • Lack of response to one kinase inhibitor does not necessarily predict lack of response to others
Vandetanib Cabozantinib	• Progressive medullary thyroid cancer	• Can be used in hereditary or sporadic medullary thyroid cancer • Responses may be seen in patients with or without *RET* gene mutations

Estrogens

- **Chemistry and Synthesis:**
  - Many steroidal and nonsteroidal compounds possess estrogenic activity (Table 44-1)
  - Steroidal estrogens arise from androstenedione or testosterone.
  - The ovaries are principle source of circulating estrogen in pre-menopausal women, with estradiol the main secretory product
  - In postmenopausal women, the principal source of circulating estrogen is adipose tissue stroma
  - In men, estrogen are produced by the testes, but extragonadal production (androstenedione & dehydroepiandrosterone) accounts for most circulating estrogens
  - Estrogen may be locally produced e.g. breast cancer, placenta

TABLE 44–1 ■ STRUCTURAL FORMULAS OF SELECTED ESTROGENS

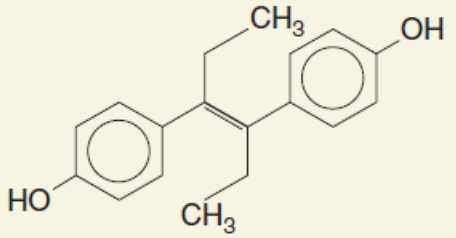
STEROIDAL ESTROGENS



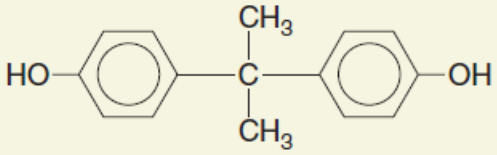
Derivative	R_1	R_2	R_3
Estradiol	—H	—H	—H
Estradiol valerate	—H	—H	—C(=O)(CH$_2$)$_3$CH$_3$
Ethinyl estradiol	—H	—C≡CH	—H
Mestranol	—CH_3	—C≡CH	—H
Estrone sulfate	—SO_3H	—[a]	=O[a]
Equilin[b]	—H	—[a]	=O[a]

NONSTEROIDAL COMPOUNDS WITH ESTROGENIC ACTIVITY

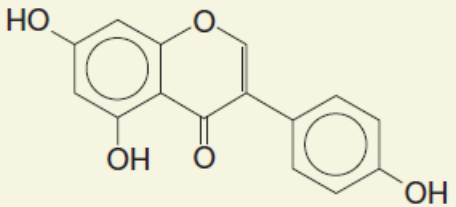
Diethylstilbestrol



Bisphenol A



Genistein



[a]Designates C17 Ketone.
[b]Also contains 7, 8 double bond.

Estrogens

- **Physiological Actions:**
  - Responsible for pubertal changes in girls & secondary sexual characteristics
  - In boys, estrogen deficiency diminishes pubertal growth spurt and delays skeletal maturation & epiphyseal closure. Est deficiency in men →↑ gonadotropins, macroorchidism, ↑testosterone, fertility in some individuals
  - Control of the menstrual cycle
  - The cyclical changes in estrogen and progesterone production by the ovaries regulate corresponding events in the fallopian tubes, uterus, cervix, and vagina → prepare the uterus for implantation→ pregnancy. If pregnancy does not occur, the endometrium is shed as the menstrual discharge
  - **Metabolic effects.** Bone remodeling (↑osteoblasts, ↓osteoclasts); bone growth & epiphyseal closure; ↑ HDL, ↓LDL; vasodilation, ↓atherogenesis

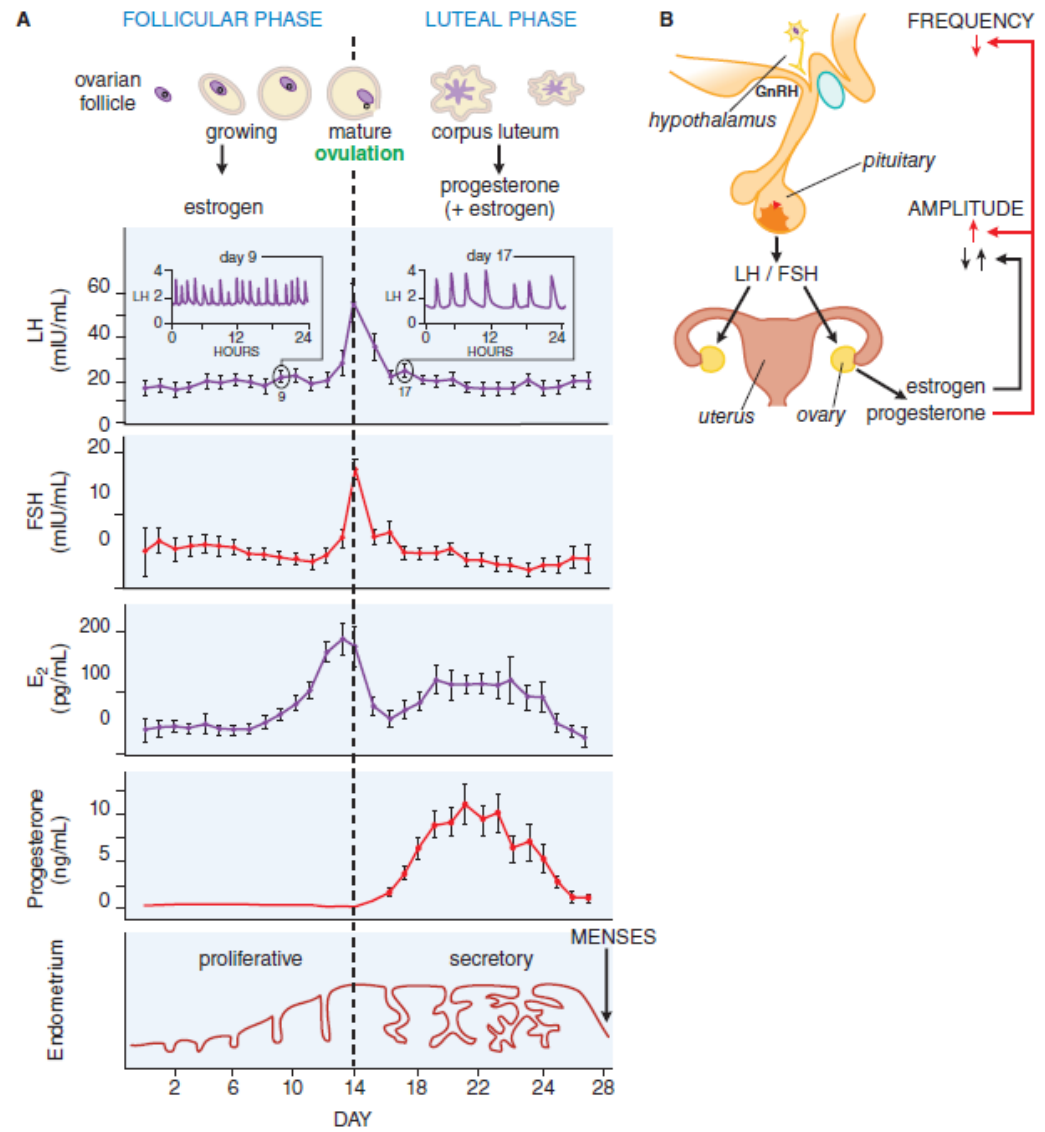


Figure 44–3 *Hormonal relationships of the human menstrual cycle.* **A.** Average daily values of LH, FSH, estradiol (E_2), and progesterone in plasma samples from women exhibiting normal 28-day menstrual cycles. Changes in the ovarian follicle (top) and endometrium (bottom) also are illustrated schematically. Frequent plasma sampling reveals pulsatile patterns of gonadotropin release. Characteristic profiles are illustrated schematically for the follicular phase (day 9, inset on left) and luteal phase (day 17, inset on right). Both the frequency (number of pulses per hour) and amplitude (extent of change of hormone release) of pulses vary throughout the cycle. (Modified from and reproduced with permission from Thorneycroft IH, et al. *Am J Obstet Gynecol,* **1971**, *111*:947–951. Copyright © Elsevier). **B.** Major regulatory effects of ovarian steroids on hypothalamic-pituitary function. Estrogen decreases the amount of FSH and LH released (i.e., gonadotropin pulse amplitude) during most of the cycle and triggers a surge of LH release only at midcycle. Progesterone decreases the frequency of GnRH release from the hypothalamus and thus decreases the frequency of plasma gonadotropin pulses. Progesterone also increases the amount of LH released (i.e., the pulse amplitude) during the luteal phase of the cycle.

Estrogens

- **Mechanism of Action:**
  - Estrogens exert their effects by interaction with receptors that are members of the superfamily of nuclear receptors
  - *Estrogen receptor* a is expressed most abundantly in the female reproductive tract—especially the uterus, vagina, and ovaries—as well as in the mammary gland, the hypothalamus, endothelial cells, and vascular smooth muscle.
- **Selective ER modulators (SERMs): Tamoxifen, Raloxifene, Toremifene**
  - Compound with tissue-selective actions
  - Produce beneficial estrogenic action in certain tissue (bone, brain, liver) during post-Menopausal Hormone Therapy (MHT) but antagonist activity in tissue breast, endometrium, where estrogenic actions (carcinogenesis) might be deleterious
  - osteoporosis

Progestins

- **Chemistry , Biosynthesis, Secretion**
  - Compounds with biological activities similar to progesterone: progestin, progestational agents, progestagens
  - Progesterone is secreted by the ovary, mainly from the corpus luteum, during 2ng half of the menstrual cycle.
  - LH acting via its G protein-coupled receptor, stimulates progesterone secretion during the normal cycle
  - After fertilization, trophoblast secretes hCG into maternal circulation, which stimulates LH receptor to sustain corpus luteum & maintain progesterone prod.
  - During 2ng and 3rd month of pregnancy, placenta begins to secrete estrogen and progesterone with fetal adrenal glands
  - Est and prog continue to be secreted in large amounts by placenta up to delivery

Progestins

- **Physiologic Actions**
  - Decreasing frequency OF GnRH pulses
  - Progesterone is secreted by the ovary, mainly from the corpus luteum, during 2ng half of the menstrual cycle.
  - Prog decreases est-driven endometrial proliferation→ development a secretory endometrium
  - Development of mammary gland
  - Prog may be responsible for increased risk of breast cancer associated with est-prog use in postmenopausal women
  - Increase basal body temperature 0,6 C at midcycle
  - Depressant and hypnotic action in the CNS
  - Increase basal insulin levels
  - Increase LDL, decrease HDL

Progestins

- **Mechanism of Action**
  - Biological activities of PR-A and PR-B are distinc and depend on the target gene.
  - In most cells, PR-B mediates stimulatory activities of prog; PR-A strongly inhibits action PR-B
  - PR-A responsible mediating effects in the ovaries, uterine; PR-B effects in mammary gland
- **Therapeutic Uses of Estrogens and Progestins**
  - Hormonal contraception
  - Postcoital contraception

Androgens

- **Testosterone and Other Androgens**
  - In men, testosterone is the principal secreted androgen
  - In women, testosterone also is the principal androgen and is synthesized in the corpus luteum and the adrenal cortex
  - Testosterone precursors androstenedione and DHEA are weak androgens that can be converted peripherally to testosterone
- **Pengertian**
  - Hormon steroid yang merangsang atau mengontrol perkembangan dan pemeliharaan karateristik laki-laki dengan berikatan dengan reseptor androgen yang mendukung aktifitas organ seks pria dan pertumbuhan karakteristik seks sekunder laki2
  - Androgen merupakan steroid anabolik

Androgens

- **Fungsi**
  - Perkembangan testis sejak embrio
  - Pembentukan sperma: di testis melalui proses spermatogenesis
  - Prekursor estrogen dan progesterone
  - Merangsang pertumbuhan rambut pada laki-laki dan perempuan
  - Perkembangan masa otot
  - Ciri seks sekunder pria: tumbuh jakun, kumis, jenggot, rambut dada, area vital; pertumbuhan masa otot, suara membesar
  - Mengatur libido seks pada laki-laki dan perempuan

Androgens

- **Mekanisme kerja**
  - Di prostat dan vesikula seminalis, 90% testosterone diubah oleh enzim 5 α-reductase menjadi dihidrotestosteron (DHT) yang lebih akif
  - Testosteron dan DHT berikatan dengan reseptor di sitoplasma →translokasi ke nukleus→ spesifik binding site→ ↑sintesis protein
- **Indikasi dan Kontraindikasi**
  - Alkil androgen: edema, angioneurotik herediter terapi jangka pendek penyakit berat
  - Kontraindikasi: wanita hamil, bayi dan anak
  - Hati2 pada pasin penyakit jantung karena risiko edema

Referensi

- Goodman & Gilman's. Manual of pharmacology and therapeutics.17th ed